

| Factor      | 2022 |        |      |        |       |        | 2023 |        |      |        |       |        |
|-------------|------|--------|------|--------|-------|--------|------|--------|------|--------|-------|--------|
|             | Leaf |        | Stem |        | Fruit |        | Leaf |        | Stem |        | Fruit |        |
|             | F    | Pr > F | F    | Pr > F | F     | Pr > F | F    | Pr > F | F    | Pr > F | F     | Pr > F |
| N Level (N) | 4.5  | *      | 1    |        | 0.08  |        | 0.6  |        | 0.8  |        | 1.2   |        |
| Compost (C) | 12.2 | ***    | 8.7  | **     | 2.5   |        | 6.2  | *      | 3.7  |        | 1.1   |        |
| Date (D)    | 9.9  | ***    | 24.2 | ***    | 15.36 | ***    | 2.0  |        | 13.1 | ***    | 5.0   | **     |
| N × C       | 5.9  | **     | 1.5  |        | 0.31  |        | 6.6  | **     | 2.5  |        | 2.4   |        |
| N × D       | 0.3  |        | 0.4  |        | 0.74  |        | 0.8  |        | 0.9  |        | 0.4   |        |
| C × D       | 0.8  |        | 1.1  |        | 1.43  |        | 0.3  |        | 0.5  |        | 1.3   |        |
| N × C × D   | 0.2  |        | 0.5  |        | 1.13  |        | 0.3  |        | 0.3  |        | 1.0   |        |

**Supplementary Table S1:** ANOVA table for treatment effects on leaf, stem and fruit tissue N of trees sampled from the Woodland site. F values are the F-test statistic for a Type III ANOVA test. Asterisks indicate the associated level of significance of the effect (\*, 0.05; \*\*, 0.001; \*\*\*, < 0.001).

| Factor      | 2022 |        |       |        |       |        | 2023 |        |      |        |       |        |
|-------------|------|--------|-------|--------|-------|--------|------|--------|------|--------|-------|--------|
|             | Leaf |        | Stem  |        | Fruit |        | Leaf |        | Stem |        | Fruit |        |
|             | F    | Pr > F | F     | Pr > F | F     | Pr > F | F    | Pr > F | F    | Pr > F | F     | Pr > F |
| N Level (N) | 0.8  |        | 3.56  | *      | 3.87  | *      | 3.4  | *      | 0.5  |        | 1.5   |        |
| Compost (C) | 0.1  |        | 0.21  |        | 0.24  |        | 7.8  | **     | 2.6  |        | 0.5   |        |
| Date (D)    | 12.3 | ***    | 11.04 | **     | 18.87 | ***    | 18.5 | ***    | 62.7 | ***    | 9.5   | ***    |
| N × C       | 0.2  |        | 0.98  |        | 1.82  |        | 1.9  |        | 0.3  |        | 0.5   |        |
| N × D       | 1.8  |        | 1.03  |        | 0.63  |        | 1.0  |        | 0.5  |        | 2.9   | *      |
| C × D       | 0.9  |        | 1.87  |        | 0.83  |        | 1.5  |        | 0.2  |        | 2.3   |        |
| N × C × D   | 0.8  |        | 0.07  |        | 0.09  |        | 1.0  |        | 0.4  |        | 0.9   |        |

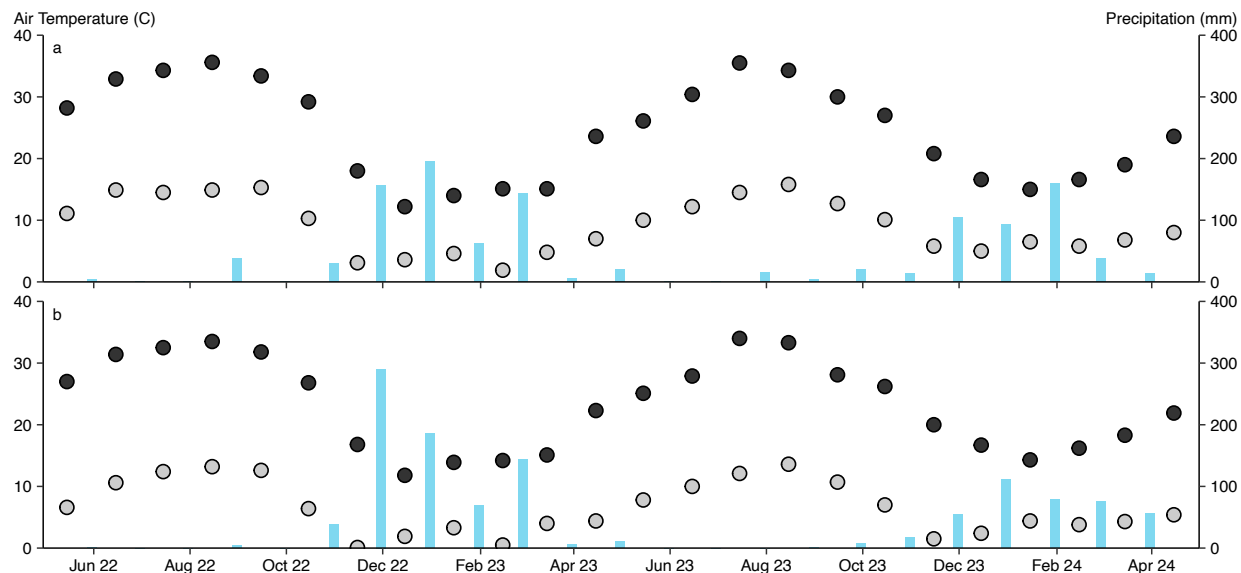
**Supplementary Table S2:** ANOVA table for treatment effects on leaf, stem and fruit tissue N of trees sampled from the Stockton site. F values are the F-test statistic for a Type III ANOVA test. Asterisks indicate the associated level of significance of the effect (\*, 0.05; \*\*, 0.001; \*\*\*, < 0.001).

| Tissue | Compost | N Level | 2022       |            |             |            |            | 2023       |            |            |            |            |            |
|--------|---------|---------|------------|------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|
|        |         |         | June 20    | July 26    | Sept. 1     | Oct. 5     | Nov. 16    | May 26     | July 7     | Aug. 2     | Sept. 8    | Oct. 19    | Nov. 16    |
| Fruit  | None    | 84      | 2.5 ± 0.5  | 4.7 ± 0.4  | 6.7 ± 0.48  | 8.2 ± 0.3  | 6.5 ± 1.8  | —          | 12.8 ± 0.2 | 11.8 ± 1.1 | 15.2 ± 2.4 | —          | 11.3 ± 1.9 |
|        |         | 112     | 1.2 ± 0.5  | 7.3 ± 2.6  | 8.0 ± 0.05  | 8.6 ± 1.0  | 9.6 ± 0.1  | —          | 17.5 ± 4.2 | 15.0 ± 1.0 | 11.4 ± 1.4 | —          | 14.0 ± 0.9 |
|        |         | 140     | 3.4 ± 2.1  | 5.7 ± 0.7  | 12.9 ± 6.07 | 13.9 ± 4.9 | 14.1 ± 6.8 | —          | 12.7 ± 3.9 | 13.2 ± 3.3 | 13.9 ± 3.7 | —          | 13.7 ± 4.1 |
|        | Compost | 84      | 5.4 ± 2.5  | 10.7 ± 3.4 | 13.2 ± 1.2  | 14.9 ± 1.9 | 16.9 ± 0.9 | —          | 12.3 ± 0.7 | 10.2 ± 1.0 | 10.2 ± 0.3 | —          | 9.9 ± 0.3  |
|        |         | 112     | 3.5 ± 0.8  | 9.4 ± 2.5  | 12.5 ± 0.4  | 13.6 ± 1.0 | 16.5 ± 2.0 | —          | 19.4 ± 2.3 | 15.3 ± 1.8 | 16.1 ± 2.1 | —          | 14.6 ± 2.2 |
|        |         | 140     | 2.3 ± 0.3  | 8.2 ± 1.8  | 11.7 ± 3.4  | 14.6 ± 3.2 | 14.7 ± 3.2 | —          | 19.5 ± 6.9 | 15.0 ± 3.3 | 13.6 ± 3.9 | —          | 7.3 ± 3.7  |
| Leaf   | None    | 84      | 1.3 ± 0.3  | 12.4 ± 5.4 | 14.2 ± 1.4  | 13.2 ± 3.0 | 11.8 ± 2.6 | 18.7 ± 2.1 | 15.1 ± 0.7 | 12.6 ± 1.3 | 10.4 ± 2.2 | 9.2 ± 3.1  | 9.2 ± 3.4  |
|        |         | 112     | 2.4 ± 1.5  | 14.1 ± 2.8 | 25.4 ± 1.9  | 25.1 ± 3.0 | 22.8 ± 2.8 | 21.8 ± 1.2 | 19.0 ± 2.9 | 17.6 ± 1.3 | 16.5 ± 3.2 | 13.2 ± 1.5 | 14.2 ± 0.4 |
|        |         | 140     | 3.3 ± 1.6  | 22.3 ± 9.6 | 24.4 ± 8.0  | 22.6 ± 6.6 | 23.2 ± 6.9 | 21.2 ± 4.3 | 18.3 ± 4.0 | 15.7 ± 4.0 | 15.2 ± 4.8 | 11.5 ± 3.4 | 10.6 ± 3.8 |
|        | Compost | 84      | 7.9 ± 4.9  | 26.2 ± 6.9 | 29.4 ± 5.6  | 24.0 ± 3.4 | 24.0 ± 5.7 | 18.3 ± 1.6 | 15.8 ± 2.5 | 14.8 ± 2.9 | 10.8 ± 2.1 | 6.3 ± 0.9  | 5.8 ± 0.5  |
|        |         | 112     | 1.9 ± 0.4  | 18.6 ± 6.2 | 21.7 ± 7.5  | 26.1 ± 5.4 | 23.2 ± 3.6 | 20.8 ± 3.4 | 18.6 ± 1.9 | 14.5 ± 1.2 | 14.4 ± 0.9 | 12.7 ± 0.3 | 12.0 ± 0.9 |
|        |         | 140     | 2.1 ± 0.4  | 15.8 ± 4.8 | 23.5 ± 6.2  | 24.1 ± 4.3 | 23.1 ± 5.5 | 21.6 ± 6.3 | 18.6 ± 4.6 | 17.2 ± 3.7 | 13.4 ± 2.8 | 9.6 ± 2.4  | 5.3 ± 2.5  |
| Stem   | None    | 84      | 2.8 ± 0.3  | 11.4 ± 4.4 | 14.2 ± 1.1  | 13.9 ± 2.7 | 12.2 ± 2.3 | 17.3 ± 1.5 | 13.8 ± 0.6 | 10.7 ± 1.8 | 9.4 ± 2.2  | 8.9 ± 3.4  | 9.0 ± 3.0  |
|        |         | 112     | 3.4 ± 1.6  | 16.6 ± 2.1 | 27.1 ± 2.2  | 23.1 ± 2.8 | 22.4 ± 2.4 | 21.5 ± 1.9 | 14.2 ± 5.2 | 15.2 ± 1.8 | 15.1 ± 2.8 | 12.4 ± 1.6 | 13.1 ± 0.1 |
|        |         | 140     | 4.8 ± 2.2  | 20.9 ± 7.8 | 23.3 ± 7.8  | 21.4 ± 6.3 | 21.9 ± 7.3 | 20.3 ± 4.8 | 17.3 ± 4.6 | 13.3 ± 3.6 | 11.8 ± 3.3 | 10.5 ± 3.5 | 9.8 ± 3.6  |
|        | Compost | 84      | 10.4 ± 5.6 | 24.4 ± 7.8 | 27.1 ± 4.2  | 21.3 ± 2.3 | 22.7 ± 4.3 | 18.1 ± 1.6 | 13.8 ± 1.8 | 11.5 ± 3.1 | 9.2 ± 2.2  | 6.3 ± 0.7  | 5.6 ± 0.6  |
|        |         | 112     | 2.9 ± 0.8  | 18.2 ± 4.8 | 23.0 ± 8.4  | 25.8 ± 4.4 | 23.1 ± 3.5 | 19.9 ± 3.3 | 16.8 ± 0.9 | 13.0 ± 0.6 | 13.2 ± 0.8 | 12.0 ± 0.3 | 11.3 ± 0.5 |
|        |         | 140     | 3.3 ± 0.4  | 16.3 ± 4.1 | 23.7 ± 5.1  | 23.0 ± 3.6 | 26.8 ± 2.5 | 21.2 ± 6.0 | 12.8 ± 5.4 | 14.4 ± 2.9 | 11.4 ± 2.6 | 9.1 ± 2.4  | 5.1 ± 2.5  |

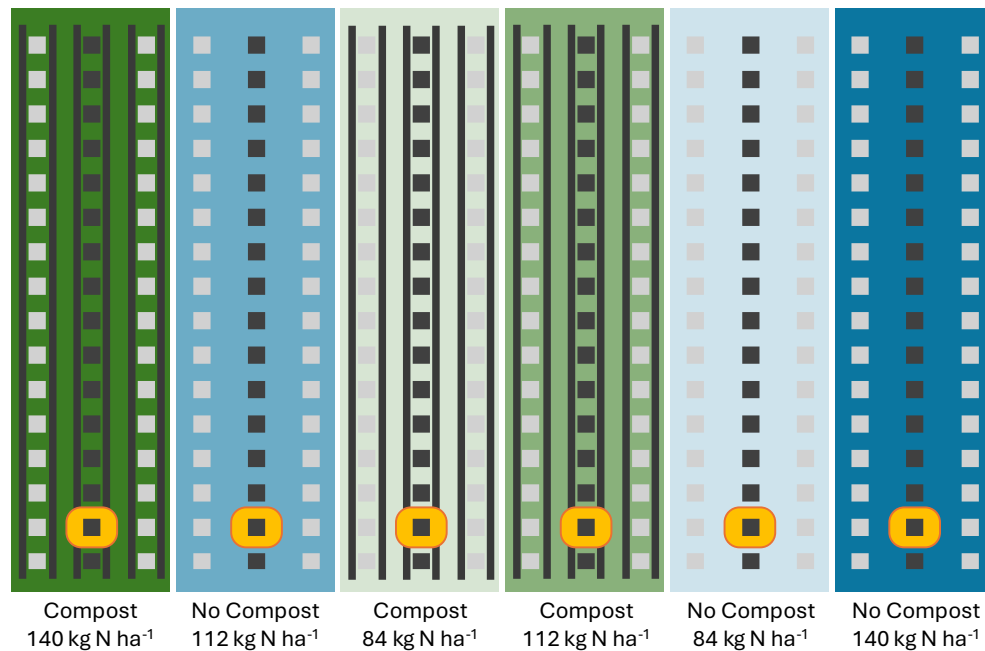
**Supplementary Table S3:** Nitrogen derived from fertilizer (% of total tissue N) for fruit, leaf, and stem tissues of olive trees sampled from the Woodland location during the 2022 and 2023 growing season. Treatments include compost application (9 T ha<sup>-1</sup>) and N fertilization rate (kg N ha<sup>-1</sup>). Values are means for each treatment group with one standard error (n = 3).

| Factor      | 2022  |        |         |       |         |       | 2023    |       |         |       |         |       |
|-------------|-------|--------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
|             | Leaf  |        | Stem    |       | Fruit   |       | Leaf    |       | Stem    |       | Fruit   |       |
|             | F     | Pr > F | F Value | P > F | F Value | P > F | F Value | P > F | F Value | P > F | F Value | P > F |
| N Level (N) | 0.51  |        | 1.0     |       | 0.7     |       | 6.19    | **    | 6.71    | **    | 3.94    | *     |
| Compost (C) | 4.07  | *      | 4.6     | *     | 15.3    | ***   | 1.32    |       | 1.43    |       | 0.01    |       |
| Date (D)    | 18.03 | ***    | 16.2    | ***   | 15.4    | ***   | 13.07   | ***   | 13.77   | ***   | 1.85    |       |
| N × C       | 5.52  | **     | 4.2     | *     | 3.7     | *     | 0.09    |       | 0.07    |       | 1.17    |       |
| N × D       | 0.47  |        | 0.6     |       | 0.4     |       | 0.31    |       | 0.26    |       | 0.46    |       |
| C × D       | 0.08  |        | 0.1     |       | 0.6     |       | 0.41    |       | 0.32    |       | 0.86    |       |
| N × C × D   | 0.27  |        | 0.3     |       | 0.2     |       | 0.17    |       | 0.12    |       | 0.85    |       |

**Supplementary Table S4:** ANOVA table for treatment effects on fertilizer-derived N uptake in leaf, stem, and fruit tissues of olive trees sampled from Woodland during the 2022 and 2023 growing seasons. F values are the F-test statistic for a Type III ANOVA test. Asterisks indicate the associated level of significance of the effect (\*, 0.05; \*\*, 0.001; \*\*\*, < 0.001).



**Supplemental Figure S1:** Weather data for the Woodland (a) and Stockton (b) sites for the two-year duration of the study. The darker and lighter points represent, respectively, the maximum and minimum average monthly air temperature (°C). The blue bars indicate the total monthly precipitation (mm). Data was obtained from nearby weather stations operated by the California Department of Water Resources as part of the California Irrigation Management Information System.



**Supplemental Figure S2:** Schematic diagram of the plot layout within a block at the Woodland location. Each block contained six plots with treatment combinations assigned in a random order. In the diagram, green indicates plots receiving compost at 9 t ha<sup>-1</sup> and blue are plots that did not. The shading indicates the nitrogen fertilization rate treatment, with darker shades indicating a higher N application rate. Each plot was composed of three rows of trees, and the middle row of trees (darker gray) was used for all measurements. In compost plots, compost was applied in band on either side of the tree rows within each plot. The sub-plots receiving <sup>15</sup>N-labeled fertilizer encompassed one tree and are highlighted in yellow. Note that row spacing and row length are not drawn to scale. Each row had approximately 160 trees. The Stockton site had a similar block arrangement but without the sub-plots for isotope labeling.